

LJ82-28

SOUTHWEST FISHERIES CENTER

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LA JOLLA, CA 92038

DECEMBER 1982

REPORT OF THE SEVENTH NORTH PACIFIC WORKSHOP

by

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and
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ADMINISTRATIVE REPORT LJ-82-28

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REPORT OF THE SEVENTH
NORTH PACIFIC ALBACORE WORKSHOP

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May 20-25, 1982

Administrative Report No LJ-82-28

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REPORT OF THE SEVENTH NORTH PACIFIC ALBACORE WORKSHOP

I. INTRODUCTION

This is the report of the 7th North Pacific Albacore Workshop. The North Pacific Albacore Workshop series originated in 1974 with an informal agreement on a joint exchange of research results for North Pacific albacore resources. The original agreement, between the Southwest Fisheries Center (SWFC, United States) and Far Seas Fisheries Research Laboratory (FSFRL, Japan) was extended in 1982 to include the Pacific Biological Station (PBS, Canada).

The 7th North Pacific Albacore Workshop was held in La Jolla at the Southwest Fisheries Center, May 20-25, 1982. Scientists from Japan, Canada, Korea and the United States participated. High utilization of the albacore resource and development of new fisheries combined with expansion of existing fisheries underscore the need to better understand the biology and dynamics of the North Pacific albacore resource.

Participants at the workshop (Appendix A) were welcomed by Dr. Izadore Barrett, Director of the Southwest Fisheries Center, who expressed his interest in the albacore resource and his appreciation of the research done. A working agenda was adopted and 13 working papers* (Appendix B) were presented to the workshop.

II. BIOLOGY, OCEANOGRAPHY, ECOLOGY AND MODELING

1. Tagging

In 1981, a few hundred tagged fish were released in eastern Pacific waters through a continuing arrangement with the American Fishermen's Research Foundation (AFRF) and the SWFC. Tagging is currently in progress (summer of 1982) by jig boats operating in the mid-Pacific (from the date-line eastward), with an objective of 1800 releases of fish in the 6-8 kg class during 1982. In addition, it is expected that 300-400 fish will be tagged in waters close to the North American coast. No acoustic tagging is planned for the summer of 1982, but further studies may be conducted in November of 1982.

*Working papers used at the 7th North Pacific Albacore Workshop were intended to promote discussions at the meeting and may be obtained by contacting individual authors directly. References to working papers are given in the text as NPALB/82/1-

Attempts by the Fisheries Agency of Japan to tag albacore in 1981 were hampered because of the unavailability of fish. Prefectural agencies were asked to tag incidentally caught albacore during the same year but the number tagged is not known at this time. The Fisheries Agency itself plans no tagging in 1982 but has asked for assistance from prefectural agencies.

2. Ageing

During a 2-year period (1977-78) a total of 2544 albacore were injected with oxytetracycline, tagged and released from fishing boats chartered by AFRF (NPALB/82/2). Of 178 recaptures, 116 were accompanied by information requisite for determining the relationship between otolith ring increments and time at liberty. The relationship is nearly 1:1, thus indicating that increments are laid down daily, at least over the size range of fish injected (51-83 cm). Demonstration that the daily ring method can be successfully used to age North Pacific albacore opens the way to validation of other, less time consuming ageing techniques, and accurate evaluation of age composition of catches.

Total ring counts from otoliths of 50 albacore in a 30-50 cm length range show that length at first birthday is about 40 cm for fish belonging to the proposed southern substock. For the northern substock, counts from only 3 specimens indicate a corresponding length of about 35 cm. Further readings are required to confirm estimates.

Progress on development of ageing techniques which utilize dorsal finrays was discussed. Samples of both otoliths and dorsal fin-rays have been collected for the purpose of validating age estimates from the latter. Results are expected later in 1982.

3. Sonic Tracking

The use of acoustic tracking to study swimming depths and diurnal behavior was continued in 1982. Two albacore were tracked from a U. S. exploratory longline vessel about 1200 miles west of southern California (NPALB/82/5). These fish exhibited similar day-night behavior, in that during daylight they swam near the bottom of the mixed layer (depths of 146-152 m) and made vertical excursions of only 15 m. At or near sunset they rose to a depth of about 107 m and from there made frequent vertical excursions of 30 m. Additional information on sonic tracking done in 1981 is given in discussion of oceanographic research.

4. Albacore Physiology

Using a continuous flow respirometer aboard a research vessel at sea, measurements were made of albacore oxygen consumption rate, $\dot{V}O_2$ (NPALB/82/3). Mean total $\dot{V}O_2$ for 6 fish weighing from 6 to 13 kg was 2,114 mlh^{-1} in water temperature of 15-19°C, a figure slightly below the average for skipjack swimming in 23-25°C water, but more than twice that for sockeye salmon measured at 15°C. As expected, tunas have much higher metabolic rates than other active fishes.

Additional tests on albacore swimming in the respirometer confirmed the adverse effects of prolonged exposure to temperatures cooler than 12°C and to O₂ saturation levels less than 55%.

5. Stock Structure

Discussions on stock structure were limited to results of electrophoretic studies. Studies conducted in 1981 revealed the presence of a single locus, phosphoglucose isomerase (PGI-A), that was highly polymorphic. A follow-up study on the allele frequencies at the PGI-A locus was conducted in 1982 (NPALB/82/6) and showed that there were no statistically significant allele frequency differences between fish taken in offshore (138°-142°W; 32-33°N) and inshore areas off southern California. Results are consistent with the interpretation that the offshore (winter-caught) fish share a common gene pool with fish which migrate into the U. S. fishery south of 40°N during summer and fall months. However, to be meaningful, statistically different allele frequencies must be demonstrated at the PGI-A locus for fish not in the hypothesized southern substock.

Work by Graves and Laurs (Southwest Fisheries Center Admin. Report No. LJ-82-11) is being conducted to determine if electrophoretic characters can be used to differentiate possible north Pacific albacore substocks. To assist in this study, frozen eye tissues will be collected from various areas and seasons during the coming year.

6. Pacific Albacore Simulation Model

The SWFC is developing a simulation model for the north Pacific albacore population. This model has been under development since late 1980 and is to be used to test hypotheses concerning the interactions between the fish, fisheries and environment.

The model forms a framework for organizing information on population dynamics, migration dynamics, life history information, economic information and environmental parameters and processes. The model is not intended to be a statistical forecasting model but rather will serve as a vehicle for evaluating hypotheses concerning albacore behavior and their dynamics. The mathematical concepts associated with the model were reviewed; participants then discussed progress in the model's development. To date, initial runs on a computer system have been made and preliminary input fishery parameters have been estimated. Prior to exacting simulations, a sensitivity analysis (NPALB/82/8) was conducted to: (1) insure that the model functions correctly; (2) identify omitted compartments and mechanisms; (3) identify unnecessary compartments and mechanisms; and (4) determine how changes of known magnitude in the input parameters affect the age- and gear-specific quarterly catches predicted by the model. Near completion is a computer program that will compare these model-predicted catches with actual recorded catches and generate an R² fit index for each simulation.

Participants also discussed the future development of the model, which will occur in two phases. In the first phase, the fishery will be simulated

over a sequence of years, both individually and as multiple-year simulations. These simulations will involve fishery data alone. In the second phase, the albacore model will be used for hypothesis testing by including, for example, environmental or economic indices as input to the model and determining to what extent their inclusion reduces the variance between observed and predicted results.

7. Oceanographic Research.

An investigation of small-scale movements and aggregation of albacore in relation to oceanic temperature and color boundaries was conducted by the Southwest Fisheries Center in cooperation with the American Fishermen's Research Foundation. Ocean color and infrared satellite data, collected contemporaneously with observations made from ships at sea, were used to investigate the small-scale migration patterns of albacore tuna in relation to oceanographic conditions.

NIMBUS 7 Coastal Zone Color Scanner (CZCS) and NOAA 6 satellite AVHRR data were collected at the S.I.O. Remote Sensing Facility in conjunction with field experiments where a) acoustic telemetering methods were used to track the horizontal and vertical movements of free-swimming albacore, and b) XBT observations were made to determine subsurface ocean thermal structure. Three albacore were tracked for approximately 24 hours and one for about 15 hours. The results showed: a) total distances tracked ranged from about 40 to 60 km with all fish remaining in the same parcel of warm water that was separated from waters to the north and inshore by a 4°F temperature gradient as shown by infrared thermal imagery, b) tracked fish spent most of the time in waters within and below the thermocline, and only small amounts of time in the upper mixed layer, c) the fish exhibited marked vertical excursions in depth with the range being larger during daytime hours than during nighttime hours, d) the fish spent the majority of the time in waters with temperatures considerably lower (about 45° to 60°F) than what has been generally believed to be the preferred temperature range for albacore (60° to 66°F) and e) when undergoing vertical changes in depth, the fish frequently within a 20-minute period passed through a vertical gradient of temperature amounting to 12° to 15°F , or about 3+ times greater than the horizontal temperature gradient at the surface indicated by ship measurements and the IR thermal imagery.

These findings indicate that the causal factor(s) involved in the aggregation of tuna on the warm side of ocean surface temperature fronts, a phenomenon which has been observed on scientific cruises, is well known by fishermen, and has economic significance, is probably not related to thermal-physiological mechanism(s) as has been previously suspected. Instead it appears that a behavioral mechanism(s) related to feeding may be responsible. Ocean color measurements made by the CZCS in conjunction with the tracking study provide data which support this hypothesis.

The diffuse attenuation coefficient (k), a measure of water clarity measured by the CZCS, showed a gradient nearly coincident with the sea surface temperature gradient pattern, with lower values of k in the warm waters and higher values in the cooler waters. The distribution of color boundaries indicated by the ratio of blue:green color bands measured by the CZCS was also

similar to the gradient pattern observed in the diffuse attenuation coefficient (k).

The results show that the albacore remained in water that had higher clarity than adjacent waters. This suggests that water clarity as it affects the tuna being able to see its prey may play a key role in the mechanism(s) underlying the aggregation of tuna on the warm clear side of ocean surface thermal fronts.

8. Environmental Modeling

Oceanographic and environmental indices are being investigated and quantified to serve as model inputs to the North Pacific albacore simulation modeling effort introduced previously. Progress was made in assembling oceanic climatological time series for use in developing environmental indices that will be candidates in the modeling efforts. In the subtropical North Pacific environmental variations may have an influence upon larval survival. One available data series is Wyrтки's island sea level differences, which may be useful in evaluating the influence of variations in ocean currents on spawning success. A second one in the subtropics is O'brien's wind stress model. Further considerations are needed to determine if output of the O'brien model can be applied as environmental input to the albacore model. Thirdly, published atlases of satellite-observed cloud patterns may offer evidence of changing wind regimes.

Climatological variations in the western Pacific may influence availability and vulnerability of albacore in the western Pacific and timing of the fishery in the eastern Pacific. Wyrтки has a temperature time series across the Kuroshio, Kawabe relates a sea level difference series to variations in the Kuroshio meander and Kawaii has data on patterns in the Kuroshio extension. In the eastern Pacific, Saur's Honolulu to San Francisco XBT time series may be used to test hypotheses on availability and vulnerability.

III. REVIEW OF CURRENT FISHERIES

1. U. S. Fishery

a. Jig/bait Fisheries

The 1981 U. S. albacore fishery was reviewed in NPALB/82/1. U. S. albacore landings were considerably higher in 1981 than during the previous two seasons, amounting to 15,500 tons in 1981 as compared to 6,600 tons and 8,200 tons in 1979 and 1980 respectively (Table 1). The 10-year average is about 20,000 tons.

In 1981 an estimated catch of 3900 mt was taken by U. S. vessels operating further offshore than they have done in past years. This includes the fishing area in the central north Pacific area as well as fishing areas 800 to 1200 miles off the North American coast. The landings made in 1981 are in part due to: 1) early catches in mid-June off California and early July off Oregon; 2) good fishing in waters 800 to 1200 miles off the coasts of Oregon

and Washington; 3) high catches of medium-sized (5.5 to 7.3 kg-12 to 16 pound) fish off California, fish which were under-represented in 1979 and 1980; and 4) late-season catches of albacore larger than 13.6 kg (30 pounds) off central California.

Size composition of albacore in the 1981 catch is presented in NPALB/82/1. The catch north of about 40°N was dominated by fish 60 to 70 cm in length; the catch south of 40°N had a smaller proportion of fish in the 60 to 70 cm length range and relatively more fish in the 45 to 55 cm and 75 to 85 cm ranges.

b. Recreational Fishery

The available private and commercial passenger vessel (PCPV) statistics for the U. S. west coast were summarized in NPALB/82/7 and combined into Table 1. PCPV catches have ranged from near zero mt (1959) to an estimated 1,700 mt in 1962. Since 1975, catches have averaged about 500 mt per year. Catches reported in Table 1 are minimum estimates due to incomplete data collection. Effort, in units of angler-trips, was estimated to be 975,000 in 1981. The 1981 catch is not yet available. Most of the PCPV effort was centered south of Monterey, California, but high catches are made off Oregon and Washington when fish are available near shore.

c. Experimental-longline Fishery

Exploratory longlining operations by six chartered U. S. fishing vessels were conducted in January-February 1982 in an area centered 1000 to 1500 miles west of San Diego (reported in NPALB/82/5). A total of 112 sets was made on the survey. Each of the vessels typically set 800 to 1400 hooks in and about the thermocline depths of 116 to 233 meters. The total catch was 322 mt albacore and 3.6 mt of bigeye tuna. The mean catch per set was equivalent to 3.2 albacore per 100 hooks (3.4 with bigeye included) and varied from 1.6 to 4.8 among the six vessels. Fuel consumption was 40% to 50% below that typical of trolling operations.

The results of the study show that the U. S. albacore fishery can operate during winter months in an area not traditionally fished, which could be an important alternative to other winter fisheries or to remaining idle. The large disparity between the catch rates of the vessels, which employed different gear settings and operational methods, shows that we have much to learn about methods, gear and distribution to improve catch rates.

2. Canadian Fishery

A total of 46 Canadian jig-boats participated in the 1981 fishery, but the catch was relatively small (202 mt). The low catch was due in part to effort diversion by the salmon fishery, and to higher fuel costs. For the first time in more than six years vessels operated far south, off the United States coast. This was due partly to a new treaty which permitted Canadian landings of albacore at four U. S. ports, and partly because the main concentrations of albacore stayed largely offshore and to the south of British Columbia. In a 64-day trip, one vessel (120 ft) operated as far south as 32°N and as far west as 178°W and landed 39 mt. Another vessel experimented with purse-seining

albacore but caught only 2.7 mt.

3. Japanese Fishery

Current progress of Japanese albacore fisheries in the North Pacific was described and pertinent fishery data were presented in NPALB/82/9. The total albacore catch from the Japanese fisheries was 66,000 mt in 1980, a 5% increase over the 1979 catch (Table 1). The 1981 catch is expected to be at the same level. While the 1981 pole-and-line fishery recorded the lowest albacore catch since 1971, the drift gillnet fishery experienced the highest albacore catch since its inception. The 1980 longline fishery remained at about the average level of the past 10 years.

d. Pole-and-line fishery

The summer pole-and-line fishing season (April-August) progressed rather poorly in 1981. Some good fishing success was encountered in the cooler water zone just outside the Kuroshio Current area from April to mid-June with the predominance of fish about 72-76 cm. However, the fishing conditions in the overall offshore "Frontal" area were generally poor; most of the catch was composed of 50-76 cm fish. The autumn pole-and-line fishing season (September-December) was also poor. Thus the season's total pole-and-line catch was low at about 26,000 mt. This low 1981 catch was attributed partly to reduced effort and poor availability. The 1982 summer pole-and-line fishery started in the usual southern area "Around Nishinochima" and fishing conditions on the nearshore albacore fishing grounds (26-28°N, 139-143°E) remained poor until mid-May. In the middle of May, fishing success improved, reaching a level that was better than that of the previous season, toward the western part of "Frontal" area.

b. Longline fishery

The North Pacific Japanese albacore longline fishery operates primarily in the winter season. The 1980 longline albacore catch was 14,700 mt, about the same as the 1979 catch. In 1981, fishing began in the central North Pacific area north of 30°N in late September and expanded in the area between 145°E and 160°W as the season progressed. Later in the fishing season, January-March, the hook rates (catch in number of fish per 100 hooks) in the nearshore waters off Japan ranged from 1.5-3.5, only about 50% of recent years' average, reflecting the poorer fishing conditions to be seen in the subsequent pole-and-line fishing season. Catch level in 1981 is assumed to be about the same as that of recent years (14,700 mt in 1980).

c. Drift gillnet fisheries

Japanese drift gillnet fisheries capture various fish species such as squid, pomfret, billfishes and tunas. The albacore are caught mainly by the large-meshed drift gillnet fishery (OME-AMI: MESH SIZE ABOUT 18 CM). During the summer months of 1981, OME-AMI fishing effort was directed mainly at albacore in the area north of 35°N between the date line and 150°W. The 1981 albacore catch is estimated to be a record high of between 15,000-20,000 mt. It was reported that very small albacore are caught incidentally by the squid gillnet fishery, and there are reports that some of these fish are being dumped because they are below minimum market size.

IV. CURRENT APPRAISAL OF THE STOCK

1. Catch, Effort and C/E Trends

a. Catch Trends

Estimated annual catches of North Pacific albacore by country and gear type are shown in Table 1 for years 1952-1981. Since the early 1960's, total catches of North Pacific albacore fluctuated annually, but showed a general increasing trend until 1976, when a peak catch of nearly 124,000 mt was recorded. During the early and middle 1970's, increased albacore catches reflected rapid development of the Japanese pole-and-line fishery. In 1977, the catch declined by 40% compared to the average of the preceding 6 years, again a reflection of sharply reduced Japanese pole-and-line catch. Catches in 1978 recovered to the 1974-77 average of 97,000 mt, but in 1979 the catch again declined, mainly because the North American catch fell to its lowest point in nearly 40 years - little more than 7000 mt.

In 1980, catch increased slightly to over 74,000 mt. While final statistics are not yet available, it appears that the 1981 total catch was between 70,000 mt and 76,000 mt. The Japanese pole-and-line catch of albacore declined to about 26,000 mt, its lowest level since 1970. However, this was offset by a phenomenal increase in the drift gillnet (OME-AMI) catch to about 15,000 to 20,000 mt.

b. Effort Trends

Effort trends within each of the three major fisheries are shown in Table 2. Effective effort of the Japanese longline fishery, the longest historical series available, shows considerable variability, but becomes relatively constant in the late 1970s at a level which corresponds to 0.75 of that in the 1960s and 1.4 times that of the early 1970s. Except for effort exerted in 1972, U. S. surface effort is rather stable, and close to the long-term (1961-78) average. Japanese pole-and-line effort experienced a conspicuous but irregular increase from the beginning of the 1970s. Recent average fishing effort was almost triple that of the 1960s. Revised fishing effort of the Japanese pole-and-line fishery, in terms of poles used (available since 1972), is rather stable except for a high in 1978, and is relatively higher in the latest years. Table 3 shows the annual change in number of Japanese pole-and-line vessels by size. These statistics do not directly reflect the change in albacore fishing effort by pole-and-line vessels, because the fleet also catches skipjack, even in the western equatorial Pacific. It was noted that the number of vessels larger than 100 gross tons, which account for more than 80% of the pole-and-line albacore catch, has continued to decline (NPALB/82/9). On the other hand, the number of large (>200 mt) drift gillnet vessels has been increasing (NPALB/82/9) and the fishery has expanded operations further eastward, with some fishing as far east as 135°W (NPALB/82/12).

c. Catch Rate Trends

CPUE of the Japanese pole-and-line fishery showed a decreasing trend from 1962 to 1981, with relatively higher values from 1970 to 1976. In 1974 a

peak catch rate of approximately 8 mt/fishing day was reported (Table 4). The catch rate reached a low of 3 mt/fishing day in 1977, then increased slightly before dropping to 3 mt/day again in 1981 (NPALB/82/9).

CPUE within the Japanese longline fishery (Table 4) showed a steady decline from the early 1950s through 1960, increased substantially through 1966 and then declined through 1971. Since then the trend in catch rate has been stable. The recent CPUEs in longline fishery on "young" fish have declined and stabilized at 2/3 the level of the average in the early to middle 1960s, when they were highest. They increased in 1980 to the highest level since 1973 (NPALB/82/9).

CPUE within the North American surface fishery showed no apparent upward or downward trend from 1961 through 1970 but declined from 1971 through 1980. CPUEs in 1979 and 1980 were the lowest observed since records began. The catch rates over the long term have been variable, being highest in the late 1960s when effort was also unusually variable. In 1981, the U. S. jigboat CPUE increased slightly to its highest level since 1978.

2. Condition of the Stock

Two papers dealing with stock assessment were presented. A production model analysis (NPALB/82/11) based on updated abundance indices and effective effort statistics, and assuming a single stock, gave estimates of MSY ranging from 92,000 mt to 166,400 mt, depending largely on the assumed shape of the equilibrium yield-effort relationship. This range of estimates is consistent with past results. Critical assumptions underlying the production model analysis may be difficult to satisfy, as discussed in past workshops.

A yield-per-recruit analysis (NPALB/82/10) was presented, using a different set of growth parameters and a larger fishable lifespan than previously assumed. Results were qualitatively the same as those found in past yield-per-recruit analyses, i.e., yield-per-recruit is maximized by harvesting albacore only after they reach a relatively large size. A contrast between the yield-per-recruit results and observed longline CPUE statistics with respect to expected decline in abundance of spawning stock was noted in NPALB/82/10. The discrepancy could be explained by an increasing trend in recruitment or by a lower fishing mortality rate than was assumed in the yield-per-recruit analysis.

Based on statistics and analyses currently available, the stock appears to be healthy. However, close monitoring is required, especially in view of increased effort in the drift gillnet fishery, about which very little is known, and because of the declining catch-per-effort in the major fisheries. Reliable assessment of the North Pacific albacore stocks remains a crucial task, beset by numerous problems. In particular, the measurement of effective effort is necessary, but is exceedingly difficult in the surface fisheries, where oceanographic processes and weather conditions strongly influence fish availability and catchability. Further, stock recruitment processes are not understood, and many questions about stock structure remain unanswered. As pointed out in past workshops, these subjects should be placed high on the research agenda of the participating laboratories. In the meantime, sensitivity analyses are needed to better define the robustness of current

assessment procedures and the direction and magnitude of possible biases.

V. RECOMMENDATIONS

The participants recommended the following research subjects as an outgrowth of the workshop discussions. The following should be undertaken:

A. Improvement of Statistics

The following is deemed especially important:

1. Fishery data, catch, catch-per-effort, and catch size composition data for the recently expanded Japanese drift gillnetting (OMI-AMI) fishery should be gathered and presented.

Also deemed important are:

2. U. S. west coast albacore data coverage, apparently lower than in the past, should be improved. Catch-and-effort data from the offshore portion of the fishery should be gathered.
3. Canadian albacore fishing data should be gathered and supplied on a more timely basis for inclusion in the general assessment of the North American fishery.
4. Statistics on the operation of Korean and Taiwan tuna boats should be investigated and historical data secured.
5. Statistical coverage of the U. S. baitboats should be evaluated and improved.
6. Statistics on Canadian and United States catches landed in ports of the other country should be gathered and separated.
7. Total catch/size composition and extent of supposed dumping of albacore incidentally caught by the squid gillnet fishery should be reported.

B. Stock Structure

1. Bio-chemical methods for stock identifications should be extended.
2. Efforts should be made to identify additional means of identifying stock structure.
3. Efforts on simulation methods should be continued to examine the consistency of stock structure hypotheses and fishing data.
4. The oceanographic mechanisms that may cause stock separation should be examined.
5. Evaluation of combined Japanese and United States tag data should be undertaken as soon as possible.

C. Biology

1. Calibration of "finray" and "daily increment" methods of age determination should be continued and extended to develop an ageing method.
2. Age and growth should be examined and stratified by area.
3. Physiology studies and further work with remote sensing tags are encouraged as a means of improving understanding of albacore behavior.

D. Stock Assessment

1. Production model analyses should be continued.
2. Yield-per-recruit analyses using revised age structures should be computed.
3. Simulation model analyses should be continued, to test hypotheses critical to other analyses.
4. Some form of spawner-recruit analysis for the stocks should be undertaken.

E. Ocean Environment

1. Oceanographic studies to identify and quantify key processes affecting the albacore fisheries should be continued for input into simulation studies.
2. Extended application of satellite remote sensing data to fisheries data should be undertaken.

VI. ARRANGEMENTS FOR NEXT WORKSHOP AND ADJOURNMENT

The Far Seas Fisheries Research Laboratory, Shimizu, Japan, offered to host the Eighth North Pacific Albacore Workshop during the summer of 1983. Meeting dates and other details will be provided by mail.

The draft report of the workshop was adopted by the participants. The meeting was adjourned.

Table 1. Catches for North Pacific albacore in metric tons, 1952-1981.

Year	Japan		Taiwan & Korea		United States			Canada				
	Pole-and-line	Long-line	Gill-net	Other gear	Total	Longline	Baitboat	Jifboat	Sport	Total	Jifboat	Grand Total
1952	41,386	26,687		237	68,710			23,843	1,373	25,216	71	93,997
1953	32,921	27,777		132	60,830			15,740		15,911	5	76,746
1954	28,069	20,958		38	49,065			12,246	147	12,393		61,458
1955	24,236	16,277		136	40,649			13,264	577	13,841		54,490
1956	42,810	14,341		57	57,208			18,751	482	19,233	17	76,458
1957	49,500	21,053		151	70,704			21,165	304	21,469	8	92,181
1958	22,175	18,452		124	40,731			14,855	48	14,903	74	55,708
1959	14,252	15,502		67	30,121			20,990		20,990	212	51,323
1960	23,156	17,369		76	42,601			20,100	557	20,657	5	63,263
1961	18,636	17,437		268	36,341		2,837	12,054	1,355	16,246	4	52,591
1962	8,729	15,764		191	24,684		1,085	19,753	1,681	22,519	1	47,204
1963	26,420	13,464		218	40,102		2,432	25,142	1,161	28,735	5	68,812
1964	23,858	15,458		319	39,635	26	3,411	18,389	824	22,624	3	62,283
1965	41,491	13,701		121	55,313	16	417	16,461	731	17,609	15	72,953
1966	22,830	25,050		585	48,465	16	1,600	15,169	588	17,357	44	65,882
1967	30,481	28,869		520	59,870	17	4,113	17,814	707	22,634	161	82,682
1968	16,597	23,961		1,109	41,667	15	4,906	20,441	951	26,298	1,028	69,008
1969	32,107	18,006		1,480	51,593	21	2,996	18,826	358	22,180	1,365	75,157
1970	24,376	15,372		956	40,704	23	4,416	21,039	822	26,277	354	67,358
1971	53,198	11,035		1,262	65,495	24	2,071	22,496	1,175	25,442	1,587	92,548
1972	60,762	12,649	1	921	74,333	25	3,750	23,600	637	27,987	3,558	105,903
1973	69,811	16,059	39	1,883	87,792	35	2,236	15,652	88	17,976	1,270	107,073
1974	73,576	13,053	224	1,065	87,918	40	4,777	20,177	739	25,693	1,207	114,858
1975	52,157	10,060	166	402	62,785	28	3,243	18,926	1,243	23,412	101	86,326
1976	85,336	15,896		1,394	103,696	37	2,700	16,314	766	19,780	252	123,765
1977	31,934	15,737	688	1,039	49,398	561	1,497	10,012	619	12,128	53	62,140
1978	59,877	13,061	4,029	3,209	80,176	53	950	15,700	871	17,512	23	97,773
1979	44,662	14,249	2,856	1,280	63,047	81	303	6,253	75	6,631	289	70,050
1980	46,743	14,660	2,986	1,516	65,988		382	7,599	174	8,155	212	
1981	26,000		20,000							15,838	200	

Remarks:

- Figures for 1979-81 are preliminary.
- Japanese longline catches for 1952-60 exclude minor amounts taken by vessels under 20 gross tons. Longline catches in weight are estimated by multiplying annual number of fish caught by average weight statistics.
- Japanese pole-and-line catches include catches by research vessels.
- United States jigboat catches include minor amounts taken by baitboats not submitting logbooks.
- Jigboat catches for years 1952-60 include baitboat catches.
- United States sport catch is a minimum estimate based on partial coverage.
- Grand totals omit unknown but minor catches by longline and pole-and-line vessels of the Republic of Korea.

Table 2. Estimated effective effort by fishery for
North Pacific albacore in years 1961-1981.

Year	Japan Longline (hooks x 10 ⁶)	Japan ¹ Pole-and-line (days) (poles x 10 ³)	U.S. ¹ Effort (days)
1952	283.0		
1953	311.1		
1954	409.6		
1955	395.3		
1956	389.1		
1957	346.4		
1958	384.3		
1959	373.7		
1960	455.5		
1961	432.0	4,235	25,255
1962	309.0	1,209	27,464
1963	259.0	4,200	31,456
1964	232.4	3,478	30,355
1965	242.7	6,628	24,945
1966	276.8	3,843	25,756
1967	434.8	5,005	26,453
1968	355.8	3,108	29,175
1969	361.2	6,447	28,528
1970	253.2	3,958	20,165
1971	255.2	7,631	44,015
1972	186.7	9,695	227.8 67,319
1973	173.5	12,685	287.8 32,031
1974	153.8	9,421	226.4 39,748
1975	158.1	8,766	204.5 35,449
1976	227.2	13,921	278.9 38,445
1977	256.2	10,609	203.4 32,292
1978	252.8	16,725	321.9 32,111
1979	278.7	12,761	252.3 17,924
1980	203.0	-	- 28,418
1981	-	-	- 20,945

¹Japanese pole-and-line days are not the same as U.S. effort days.

Table 3. Number of Japanese pole-and-line vessels by size.

Year	Total Number	Size of Vessel (gross tons)				
		<20	20-50	50-100	100-200	200>
1961	5523	5046	141	132	178	26
1962	4460	4009	186	111	126	28
1963	6533	6041	240	111	112	29
1964	4361	3829	291	103	106	32
1965	4226	3654	298	91	148	35
1966	4191	3620	299	71	167	34
1967	4114	3550	296	54	173	41
1968	3231	2670	276	60	170	55
1969	4008	3475	242	71	158(2)	56(3)
1970	3666	3148	220	91	143(3)	64(3)
1971	3684	3168	165	133	132(3)	86(3)
1972	4156	3596	131	162	119(3)	148(3)
1973	3587	2998	93	211(1)	83(3)	202(3)
1974	3941	3225	136	269	84	227
1975	3344	2648	95	283	39	279
1976	3754	3101	51	318	17	267
1977	4010	3348	40	348	14	260
1978	3680	3035	26	358	10	251
1979	4105	3480	14	370	13	228
1980	3804	3232	14	350	10	198
1981	-	-	-	-	-	-

() shows the number of prefectural research vessels included.

Table 4. Actual CPUE¹ statistics for major North Pacific albacore fisheries, 1981-1980.

Year	Fishing days	Japan Pole-and-line Poles	United States jig	Japan Longline		
				"Young" area(2)	"Main spawning" area(3)	Entire area(4)
1961	4.40		69.17	0.55	0.14	0.25
1962	7.22		124.59	0.67	0.14	0.30
1963	6.29		132.09	0.68	0.19	0.32
1964	6.86		97.61	0.90	0.19	0.40
1965	6.26		89.07	0.70	0.25	0.33
1966	5.94		90.45	1.20	0.27	0.54
1967	6.09	259	126.83	0.88	0.29	0.40
1968	5.34	227	135.23	0.84	0.29	0.38
1969	4.95	211	112.57	0.60	0.31	0.28
1970	6.13	261	127.39	0.66	0.27	0.31
1971	6.94	295	96.68	0.43	0.22	0.21
1972	6.25	266	61.08	0.63	0.30	0.30
1973	5.49	242	82.89	0.85	0.30	0.38
1974	7.81	325	105.17	0.64	0.30	0.34
1975	5.98	255	99.81	0.46	0.21	0.23
1976	6.13	306	69.22	0.66	0.21	0.30
1977	3.01	157	59.90	0.60	0.14	0.26
1978	3.58	186	86.80	0.52	0.17	0.23
1979	3.50	187	45.41	0.53	0.21	0.24
1980	4.44	268	36.78	0.72	0.26	0.33
1981	3.05	-	80.11	-	-	-

¹Unit: MT/vessel-day and kg/pole-day for Japan pole-and-line; fish/vessel-day for United States jig; fish/100 hooks for Japan longline

(2) "Young" area is 25°-45°N from October to March and 30°-45°N

(3) "Main spawning" area: 10°-25°N

(4) Entire area: 0°-45°N

APPENDIX A

PARTICIPANTS
7TH NORTH PACIFIC ALBACORE WORKSHOP

May 20-25, 1982

Barry Ackerman	-	Fisheries and Oceans, Vancouver, Canada
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APPENDIX B

7TH NORTH PACIFIC ALBACORE WORKSHOP

LIST OF WORKING PAPERS

- NPALB/82/1 Laurs, R. M. and N. W. Bartoo. Review of the 1981 U. S. North Pacific Albacore Fishery.
- " 2 Laurs, R. M. and R. N. Nishimoto. Results from tetracycline experiment to evaluate otolith daily ring increment method for age determination in North Pacific Albacore and from otolith daily ring counts made on whole otoliths to determine length at first birthday.
- " 3 Graham, J. B. and R. M. Laurs. Metabolic rate of the albacore tuna Thunnus alalunga.
- " 4 Laurs, R. M. Small-scale movements and aggregation of albacore in relation to ocean temperature and color boundaries.
- " 5 Laurs, R. M., R. Lynn, R. Dotson, R. Nishimoto, K. Bliss and D. Holts. Exploratory albacore longline fishing in the eastern north Pacific during winter 1982.
- " 6 Graves, J. E. and R. M. Laurs. Phosphoglucose isomerase phenotypes of inshore and offshore populations of North Pacific albacore.
- " 7 Holts, D. B. Available albacore partyboat statistics.
- " 8 Weber, E. C. A sensitivity analysis of the Pacific albacore model.
- " 9 Shiohama, T. Review of the current Japanese North Pacific albacore fisheries, 1982.
- " 10 Shiohama, T. Yield-per-recruit model analysis on albacore stock in North Pacific.
- " 11 Kume, S. An approach to evaluate the stock status of North Pacific albacore by production model analysis.
- " 12 Bartoo, N. 1981 United States albacore surface fishery catch distribution determined from logbook records.
- " 13 Bartoo, N. and S. Kume. Report of the Sixth North Pacific albacore workshop.

